Space Weather Technical Forecast

Issued on Friday, 15 July 2022 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1-R2 blackouts likely, with a slight chance of R3 blackouts and S1. Active electron fluence expected later in period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with two M-class flare and numerous C-class flares observed over the past 24 hours. There are currently five sunspot regions on the visible disc, four numbered, and all large groups in size, and some moderately magnetically complex. The new, yet to be numbered, region in the northeast is currently hard to asses as it is still close to the eastern limb, but it's classification is likely to be upgraded as it rotates onto the visible disc, as this region produced the two M-class flares. A CME was associated with the first flare, but this is unlikely to be Earth directed. A second CME was emitted from the Sun later in the day, most likely from a filament on or close to the southeast limb, and this CME is also not expected to be Earth directed. Numerous large filaments remain on the visible disc, with currently some movement from a filament in the southern hemisphere, which will be monitored.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has been elevated, predominantly between 520-570 km/s, peaking at 586 km/s at 14/0610 UTC. The density was slightly above average, with a maximum reading of 16 ppcc at 14/0149 UTC. The IMF was initially weak, then increased to moderate levels after 14/1035 UTC. The Bz was initially positive but became negative from 14/1436 UTC, although weak with a maximum of -4 nT reached. The phi angle was positive (away from the Sun). These parameters would suggest that Earth is under the influence of a high speed stream, most likely from coronal hole 99. Corresponding geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16, is at background levels. The high energy electron flux (greater than 2 MeV) started at background to moderate levels, but gradually increased to predominantly moderate levels, peaking at 283 pfu at 14/1830 UTC. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold, but with a steady rising trend. The observed fluence at 15/0000 UTC was 6.69e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Moderate, with a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: Solar winds are expected to remain elevated on day 1 (15th) due to the HSS originating from CH99/+. Through day 3 (17th) solar winds are forecast to decrease to slightly elevated levels, then possibly down to background levels by the end of the period as the coronal hole effects wane. No Earth directed CME's are currently expected during the period. Predominantly Quiet (Kp 0-2) geomagnetic activity is expected, with isolated Unsettled (Kp 3) intervals possible.

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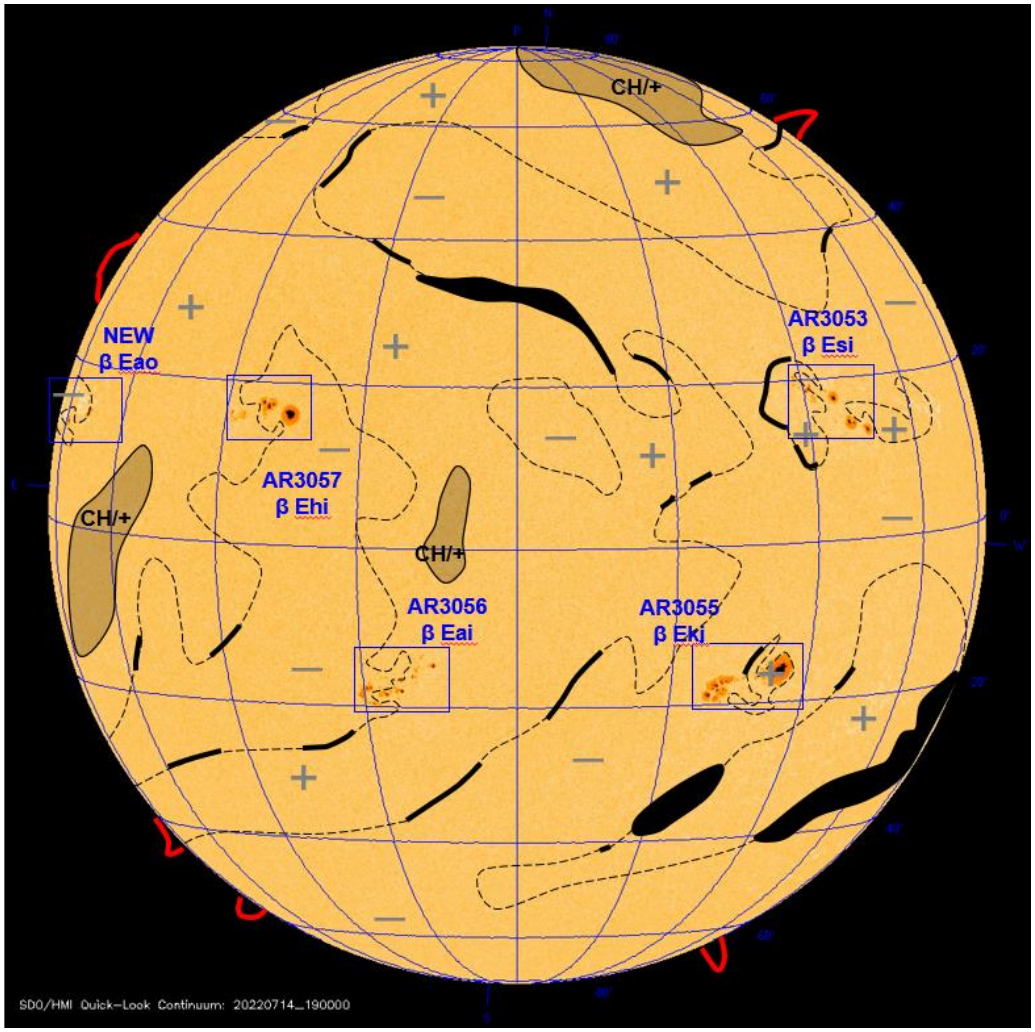
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels. There is however a daily Slight Chance of S1 or greater event, due to the presence of 2 relatively large sunspot regions transiting across the western hemisphere.

The high energy electron flux (greater than 2 MeV) is expected to increase over the coming days, with diurnal maxima exceeding the High (1e3 pfu) threshold possibly today, but more likely from tomorrow (16th). Fluence levels are also expected to increase, and are expected to exceed the Active (1e8 integrated pfu) threshold, most likely during day 3 (17th).

Figure 1. Solar Analysis Valid 14/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No CMEs feature in this forecast.

Solar winds are expected to remain elevated on day 1 (15th) due to the HSS originating from CH99/+. Through either late tomorrow, or more likely during day 3 (17th) solar winds are forecast to decrease to slightly elevated levels, then possibly down to background levels by the end of the period as the coronal hole effects wane. This is a similar trend to the previous rotation.
Predominantly Quiet (Kp 0-2) geomagnetic activity is expected, with isolated Unsettled (Kp 3) intervals possible, mainly today and tomorrow while the solar wind remains elevated.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate in the last 24 hours, with a M1.2 flare during the early hours of 14th UTC and a M2.8 at 14/2148 UTC, both from the new region near the northeast limb. The background flux remains at C-class level.

Further occasional M-class flares are considered likely, with a slight chance of an isolated X-flare. Although currently the most likely source for this activity is the new region in the northeast, all the remaining four numbered sunspot regions are large with Eki/Esi/Eai/Ehi and Eao classifications, plus some potentially magnetically complex as beta-gamma's.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	10	10	10	10

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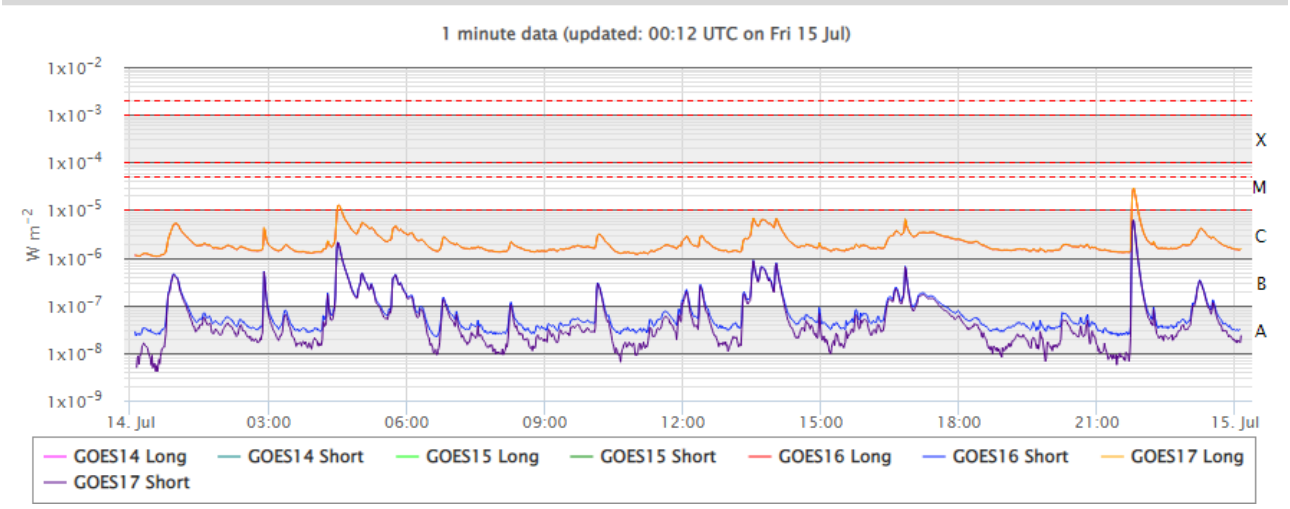
Figure 2: Past 24 hours x-ray flux.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. There is a slight chance of an S1 or greater, due to the presence of two large sunspot regions (AR3053 and AR3055) transiting across the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at moderate levels. The current elevated solar wind speeds will cause some electron charging over the coming days, with the electron flux levels forecast to increase. It is expected that the 1e3 pfu Active flux threshold will be breached near the diurnal maximum on days 2-4 (16th-18th). Corresponding electron fluence levels are also expected to increase, and are expected to exceed the Active (1e8 integrated pfu) threshold, most likely late day 3 (17th).

Therefore, the Met Office REFM model is considered to be providing good guidance, showing a rising trend, but as the model is currently over-estimating the fluence, the Active threshold is expected to be breached slightly later than indicated by the model.

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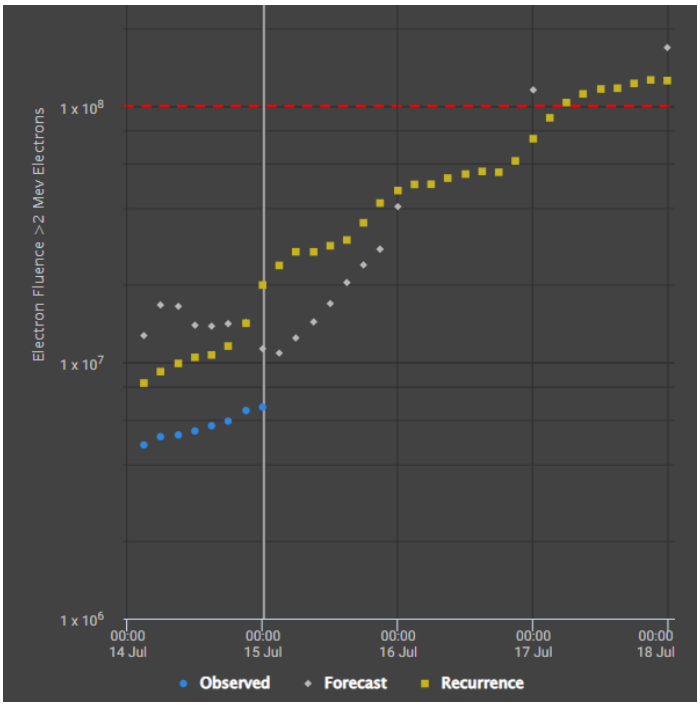
GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	40	60	80
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 3: Met Office REFM model.



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